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A Crisis of Confidence:

Understanding Money Markets during the Financial Crisis

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Abstract

The money markets are at the heart of the recent financial crisis and are the subject of substantial news coverage. However, much of what was reported showed a lack of understanding of money markets in general and, a specific lack of understanding as to why the financial crisis unfolded as it did in these markets. The purpose of this paper is to discuss what actually happened and why. Specifically, we discuss: (1) the economic role of the money markets, (2) the institutional features of the money markets central to the financial crisis and, (3) what actually happened in the various money markets.

A Crisis of Confidence: Understanding the Money Markets during the Financial Crisis

BNP Paribas, a large French bank, temporarily halted redemptions from three of its funds holding assets backed by US subprime mortgage debt on August 9, 2007 signaling the beginning of the financial crisis which had been looming, unknown to the public, for several months.¹ Quoting from the BNP press release on that day, “*(t)he complete evaporation of liquidity in certain market segments of the U.S. securitization market has made it impossible to value certain assets fairly regardless of their quality or credit rating.*” The next day, the interest rate spread of overnight asset-backed commercial paper over the Federal funds rate increased from 10 basis points to 150 basis points and the Federal Reserve Board announced it would provide the necessary liquidity to promote trading in the federal funds market close to the target rate of 5.25%.

One week later, on August 16, 2007 Countrywide Financial (then the largest US mortgage lender) announced it had borrowed \$11.5 billion from a group of 40 banks. The loan was necessitated by Countrywide’s inability to borrow in the commercial paper market, as it had done regularly in the past. To provide some context for the size and importance of this event, consider that, earlier that year on March 31, 2007, Countrywide held \$208 billion in total assets with \$32.2 billion in Mortgages Held for Sale and \$16.8 billion in Trading Securities Owned.² These trading accounts were funded in part with \$9.8 billion in asset-backed commercial paper and \$8.7 billion in unsecured commercial paper. Thus, commercial paper represented almost 40% of the funding of Countrywide’s trading assets just prior to the financial crisis.³

On the following day (August 17, 2007), a Federal Reserve Board press release stated:

“To promote the restoration of orderly conditions in financial markets, the Federal Reserve Board approved temporary changes to its primary credit discount window facility. . . (and) a 50 basis point reduction in the primary credit rate to 5¾ percent, to narrow the spread between the primary credit rate and the Federal Open Market Committee's target federal funds rate to 50 basis points. The Board is also announcing a change . . . to allow the provision of term financing for as long as 30 days, renewable by the borrower. These changes will remain in place until the Federal Reserve determines that market liquidity has improved materially.”

Money markets being at the center of the financial crisis meant substantial media coverage in both the financial and popular press as the crisis progressed. However, much of what was reported about the money markets showed a lack of understanding of money markets in general and a specific lack of understanding as to why the financial crisis unfolded as it did in those markets. Specifically, unlike previous bank panics when bank runs were retail in nature - runs instigated by individuals rushing to withdraw their funds on deposit and the banks failing because they were unable to meet those demands - the 2007-2009 financial crisis was ‘wholesale’ in nature. This panic involved financial firms creating runs on other financial firms primarily (as discussed later) by not renewing repurchase agreements (repos) or by increasing the repo margin (Gorton, 2009a, 2009b).

The purpose of this paper is to highlight how the financial crisis played out in the money markets. We begin with a discussion of the economic role of the money markets, as it drives the market structure. We then turn to a brief description of how money market mutual funds (MMFs), the traditional banking sector, and the “shadow” banking sector interact within the money markets and how this resulted in a substantial increase in the number, outstanding amount, and liquidity of traditional money market instruments. Finally, we discuss each major money market instrument that was significantly affected

by the crisis, how each market responded to the financial crisis, and any actions taken to counteract the impact of the crisis.

I. The Economic Role of Money Markets

The structure of the money markets stems from the unique role they play in the trading of liquidity. These are the primary markets where lenders with temporary cash surpluses make short-term loans to borrowers with temporary cash shortages.

The key feature is that lenders (investors) have *temporary* cash surpluses. Often, this cash surplus is associated with a specific obligation in the near future (less than one year) and the lenders will only make a loan if they are confident that the cash will be returned in time to cover the identified liability. Because payment of the obligation is vital to the ongoing financial health of the lender, the temporary cash surplus will not be put at undue risk. A simple analogy is a homeowner who receives a bi-monthly paycheck but has monthly mortgage payments at the beginning of each month. A portion of the mid-month paycheck goes toward the mortgage payment, but will not be needed for two weeks. The homeowner can allow the cash to sit idle for two weeks or can invest as long as the cash is certain to be available later to satisfy the mortgage liability. Because there is a specific time horizon for the investment and because the funds are needed for a specific purpose, default risk is unacceptable.

This demonstrates the mindset of money market investors and highlights the three primary characteristics common to all money market securities, namely:

1. Short-term debt contracts with
2. Low default risk and
3. High marketability.

Using short-term debt contracts allows lenders to schedule precisely the return of their temporary cash surpluses. Because the cash meets an identified need, lenders will only lend to low default-risk borrowers. Finally, since unforeseen cash obligations can arise, lenders also require the ability to get their funds returned early without significant penalties or price concessions. If these three features cannot be met satisfactorily, lenders will decline to make the loan rather than put their temporary surplus at risk. Understanding this last point goes a long way in appreciating why the money markets supposedly “locked up” during the recent financial crisis. To emphasize the importance of confidence in the money markets and financial markets overall, consider the following quote from the Examiner’s Report on the underlying causes of the Lehman Brothers failure:

*Lehman failed because it was unable to retain the confidence of its lenders and counterparties and because it did not have sufficient liquidity to meet its current obligations.*⁴

II. The Role of Money Market Mutual Funds, Banks, and Shadow Banking

The trading of liquidity requires the matching of short maturity lenders with short maturity borrowers, for example the funding inventory with commercial paper. Thus, money market borrowers convert short-term assets to cash to repay the short-term lenders.⁵ The normal minimum transaction size in the money markets is \$5 million which makes trading in traditional money market securities out-of-reach for most non-institutional short-term lenders.

A. Money Market Mutual Funds

We begin our discussion with money market mutual funds (MMF) which are large institutional portfolios that hold money market securities. In holding these short-term securities there is no maturity intermediation rather, the benefit of MMFs is one of denomination intermediation. That is, MMFs pool funds from many investors (lenders) to acquire money market securities. They allow individual investors to participate in small dollar increments (typically \$100).

The portfolio of assets in a MMF also provides some diversification benefits, but not in the traditional sense of ‘up’ stocks offsetting ‘down’ stocks because an ‘up’ money market security is one that repays the lender and a ‘down’ one is one that defaults. Instead, the diversification is simply that investors do not have all of their funds in one security. Rather, they have a claim on the entire MMF thus providing some risk reduction. However, MMF investors are exposed to liquidity risk as there is not a secondary market for MMF shares and funds have the ability to deny withdrawals.

Data from the Federal Reserve H6 release shows total assets of MMFs in December of 2006 at \$2.18 trillion. This amount increased to \$3.51 trillion in December of 2008, but has declined through the recession to \$2.60 trillion in December 2010.

B. Banks

Banks take (predominantly short-term) deposits which they bundle to fund a portfolio of loans and provide denomination, risk and maturity intermediation. Banks take deposits in any dollar amount allowing anyone wanting to store liquidity a place for that storage (denomination intermediation). Depositors have a claim on the bank (supported by its portfolio of loans) which provides risk intermediation and, banks take in

relatively short-term deposits that vary from demand deposits to multi-year time deposits while making relatively long-term loans that extend as far out as 30 years for mortgages (maturity intermediation).

Having a claim against the bank and its loan portfolio instead of a specific borrower reduces depositors' risk, but does not eliminate it. To further reduce risk and to provide for a safe and sound banking system, the US has a deposit insurance system through the Federal Deposit Insurance Corporation (FDIC) to protect depositors. Prior to the financial crisis, MMF investors did not have these same protections. One of the programs designed to limit the financial crisis is a program of assurances to MMF investors that their funds are safe.

Maturity intermediation creates an exposure to liquidity risk because depositors can withdraw their funds before loans mature and banks are required to meet all withdrawal requests. To manage the liquidity risk, banks hold both cash and money market securities. However, MMFs hold little cash because of the need to generate returns and instead, generally meet withdrawals from new inflows, from maturing money market securities or from selling money market securities.

Gorton (2009a, 2009b) points out that traditional banks also produce “informationally insensitive” debt that can be used for transactions.⁶ In the extreme, these securities are quasi-risk-free, like insured deposits. But other types of debt can also have this characteristic. For example, studies of corporate bond returns and bond yield changes have generally concluded that investment-grade bonds behave in a fashion similar to that of Treasury bonds when reacting to interest rate changes. In contrast, below investment grade bonds are more sensitive to firm-specific information.

An investment grade bond can suffer losses if the issuer fails but, if the security represents a portfolio of bonds where the firm can segregate specific cash flows and sell claims specifically linked to these cash flows, which can be accomplished by setting up a Special Purpose Vehicle (SPV) as discussed below, then the ‘informationally insensitive’ characteristic can be retained. Other important characteristics of the traditional banking sector include the exponential development of the market for derivatives and its concomitant demand for collateral (for hedging and margin purposes) and perhaps just as importantly, the movement of massive amounts of loans originated by banks into the capital markets in the form of securitization and loan sales (discussed in the following section).

C. Shadow Banking

Pozsar et al. (2010) define shadow banks as financial intermediaries that, like traditional banks, conduct maturity, credit, and liquidity transformation, but do not have access to central bank liquidity or public sector credit guarantees such as deposit insurance. They report the size of the shadow banking system peaked at \$20 trillion in March 2008, more than 1.5 times the asset of traditional banks.

In the shadow banking sector, funds are borrowed and used to invest in portfolios of relatively long-term assets. One of the main providers of funds to this sector is the MMFs, which creates a number of notable issues:

[1] Investing in relatively long-term assets moves away from the types of assets traditionally funded with money market borrowing.

[2] The shadow banking sector borrows in the money markets so there is no issue of denomination intermediation.

[3] The shadow banking sector does not have risk intermediation. Instead, it engages in risk reduction by investing in a portfolio of assets, but as with MMFs and banks, the diversification is only through investing in a range of different securities. Additionally, the portfolios have third party credit support through credit ratings and liquidity guarantees and,

[4] The shadow banking sector provides maturity intermediation. However, the maturity mismatch creates liquidity risk (which became apparent during the financial crisis). That is, the shadow banking sector relies on its ability to roll its money market borrowings.

The financial crisis occurred when money market investors (i.e., MMFs and their shareholders) became concerned about the value and liquidity of their portfolios should the counterparty credit support fail.

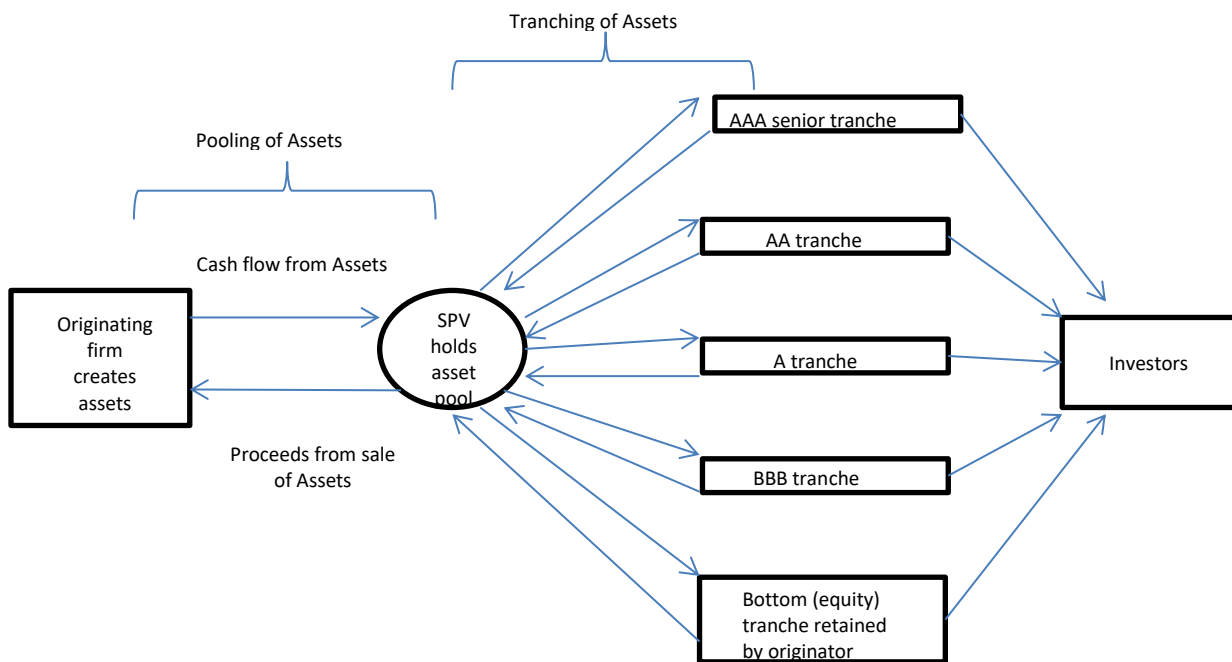
The largest cash providers in this market are MMFs (25%-33%) and securities dealers (25%) that seek short-term investments for their temporarily available cash (Copeland et al, 2010). Agapova (2011) suggests that mutual fund families and their investors use MMFs as cash centers. The growth in MMFs provided a substantial portion of the cash that funded the shadow banking sector. There were also over 4,000 individual firms active as cash investors. We have access to the data on the portfolio composition of asset-backed commercial paper programs and find that the major asset categories include: securities (such as mortgage-backed securities), commercial loans, credit card and trade receivables, student loans, and auto loans. Other than trade receivables, these asset

categories are not the types traditionally funded by money market lenders as they do not have the short maturities required to repay the money market lenders.

The shadow banking sector evolved as a result of increased competition from non-banks, principally the money market mutual funds, decreased regulation and the innovation of financial instruments. In the early 1980's interest rate ceilings were eliminated and banks were allowed to conduct business in a number of different financial activities. Derivatives and the concomitant need for collateral became more important; loans became more liquid and could be sold into the secondary market, but most importantly, securitization allowed portfolios of loans to be sold into the capital markets.

Securitization is a form of off-balance sheet banking in which bank loans are sold to a special purpose vehicle (SPV), a legal entity which finances the purchase of the portfolio by issuing investment grade securities to the capital markets, including money market securities. The SPV is robotic in that it is essentially a 'shell' corporation; no one works there and there is no physical location. Servicing the loans is outsourced and the cash flow from the loans is allocated to the different investment tranches according to pre-specified rules (see Figure 1). Importantly, SPVs are bankruptcy remote, meaning that the failure of the originator of the loans is not relevant to the investors in the securitized bonds. That is, in the event of bankruptcy, the originator of the loans cannot reclaim the assets now in the SPV. Also, the SPV itself cannot go bankrupt. If the cash flow from the loan portfolio that constitutes the assets of the SPV is insufficient for making payments, then early amortization is triggered. We reproduce below a typical schematic of the securitization process:

Figure 1: The Securitization Process



Note that the riskiest portion of the asset pool, the equity tranche, is generally retained as a mark-to-market investment on the balance sheet of the originator, usually a large investment or commercial bank. However, in mid-2000s originators often were able to sell even the equity tranches to investors, and thus faced little risk. Gorton and Metrick (2010) report that according to Federal Reserve Flow of Funds data, the ratio of off-balance-sheet funding to on-balance-sheet loan funding grew from zero in 1980 to over 60 percent in 2007.

Why did this type of financing vehicle become so popular? In addition to the arguments made above about the need for collateral, there also existed an opportunity for *regulatory and ratings arbitrage*. Brunnermeier (2009, p.80) points out:

“The Basel I accord (an international agreement that sets guidelines for bank regulation) required that banks hold at least 8 percent of the loans on their

balance sheets; this capital requirement. . . was much lower for contractual credit lines. Moreover, there was no capital charge at all for “reputational” credit lines – noncontractual liquidity backstops that sponsoring banks provided to structured investment vehicles... Thus, moving a pool of loans into off-balance-sheet vehicles, and then granting a credit line to that pool to ensure a AAA-rating, allowed banks to reduce the amount of capital they needed to hold. . . while the risk for the bank remained essentially unchanged.”

According to Acharya et al. (2010), the SPV sponsors also provided four different types of guarantees (all of which reduced bank capital requirements) which provided different levels of insurance to outside investors. The results of their analyses suggest: [1] during the first year of the crisis, asset-backed commercial paper issuance and maturity fell and spreads increased especially for SPVs with weaker guarantees, riskier banks and lower quality assets, [2] banks with more exposure to SPVs had lower stock returns and [3] losses from the SPVs remained with the banks rather than outside investors. That is, as the guarantees were called to make the outside investors whole, the losses were taken on the banks’ balance sheets and massive deleveraging (see section III.C) took place with the ensuing downward pressure on asset prices.

We define the vehicles and conduits more extensively in Section III.B. For the present, it is important to understand why this shadow system must be recognized as part of the total banking system. Securitization through the use of off-balance sheet special investment vehicles (SIVs) and SPVs involves the issuance of bonds that can be used extensively as collateral in sale and repurchase agreements (repos) which are discussed more extensively in Section III.C, freeing other categories of assets, mostly treasuries, for use as collateral in derivative transactions and for use in settlement systems. Repos therefore are a form of “deposit” of short-term money backed by highly rated collateral just as deposits are backed by FDIC guarantees. Gorton (2009b) states that by March 4,

2008 primary dealers reported financing \$4.5 trillion in fixed income securities with repos.⁷

III. Money Markets

The traditional money market instruments are: Treasury bills (T-bills), short-term agency debt, commercial paper (CP), repurchase agreements (repos), federal (fed) funds, negotiable certificates of deposits (CD) and bankers' acceptances (BA). In this paper, we discuss only T-bills, CP, repos, and fed funds. Short-term agency debt and negotiable CDs are excluded because these markets were not major factors in the financial crisis. BAs are excluded because their use has declined to the point where it is not an economically important market given the amount of trading in the other money market instruments.⁸ We also include a discussion of bank interactions with the money markets and Federal Reserve policy actions because each plays an important role in the financial crisis.

A. T-bills

As previously stated, money market lenders require short-term debt contracts with low-default risk borrowers and with a liquid secondary market should they need to sell prematurely. US Treasury bills (T-bills) have initial maturities of one year or less with no default risk and a liquid secondary market. Because of these characteristics, T-bills are often referred to as the ideal money market security. The flip side of this coin is that all other money market securities are less than ideal because the others have either more default risk than T-bills, less liquidity than T-bills or both.

When there is a crisis of confidence, i.e., concerns about increased default risk or concerns about the true value of otherwise highly rated collateral, investors often move to less risky securities in what is described as ‘a flight to quality.’ Treasury securities have the ultimate quality under such conditions and such flights increase the demand for T-bills, increasing their prices and decreasing yields. To demonstrate this point, we provide in Table 1 the T-bill auction results from September 2007 (the beginning of the crisis) and September 2008 (one year into the crisis).

Table 1

September 2007			September 2008		
Date	Maturity	Yield	Date	Maturity	Yield
9-4-07	26-week	4.380%	9-4-08	26-week	1.890%
9-4-07	13-week	4.350	9-4-08	13-week	1.685
9-4-07	4-week	4.280	9-4-08	4-week	1.540
9-13-07	26-week	4.020	9-4-08	6-day	2.000
9-13-07	13-week	3.800	9-11-08	26-week	1.900
9-13-07	4-week	4.000	9-11-08	13-week	1.690
9-13-07	4-day	4.620	9-11-08	4-week	1.575
9-20-07	26-week	4.130	9-18-08	26-week	1.550
9-20-07	13-week	4.050	9-18-08	13-week	1.050
9-20-07	4-week	3.930	9-18-08	4-week	0.300
9-27-07	26-week	4.000	9-18-08	35-day	0.300
9-27-07	13-week	3.820	9-19-08	76-day	0.254
9-27-07	4-week	3.270	9-19-08	20-day	0.100
			9-22-08	59-day	1.990
			9-22-08	45-day	1.800
			9-25-08	52-week	1.955
			9-25-08	26-week	1.790
			9-25-08	13-week	1.420
			9-25-08	4-week	0.350
			9-25-08	7-day	0.050
			9-26-08	34-day	0.990
			9-29-08	101-day	1.650

Under pre-crisis Treasury auction rules, the regular weekly T-bill auction covered 4-week, 13-week and 26-week T-bills. Any T-bills with different maturities are cash management bills which are issued through off-cycle auctions to cover unusual needs as

determined by the Department of the Treasury. A then typical year averaged one or two cash management bill issues per month. The data in the table for September 2007 represent a typical month with regular weekly auctions of 4-week, 13-week and 26-week T-bills and one cash management auction, the 4-day bill issued on September 13. The yields in September 2007 are also fairly typical for pre-crisis T-bills. September 2008, however, is not. There are nine cash management auctions and, there is an auction for a 52-week T-bill. Historically, the Treasury had regular auctions in 52-week bills, but these were discontinued in February 2001.⁹ Also, the yields are very low. In fact, on the 7-day bill on 9-25-08 the yield is only 5 basis points which, over 7 days represents \$0.01 of interest per \$1,000 invested (note, the target fed funds rate is 2.0% for overnight funds at this time). A round lot in the Treasury bill market is \$5 million, meaning it would earn \$50 of interest. The data from September 2008 are consistent with a flight to quality.

All of the yields from September 2008 are less than any estimate of expected inflation at the time implying that investors in these bills are expecting negative real returns. Normally, one might consider buying an investment with an expected negative real return to be irrational. However, during a crisis of confidence investors put the preservation of principal ahead of all other concerns.

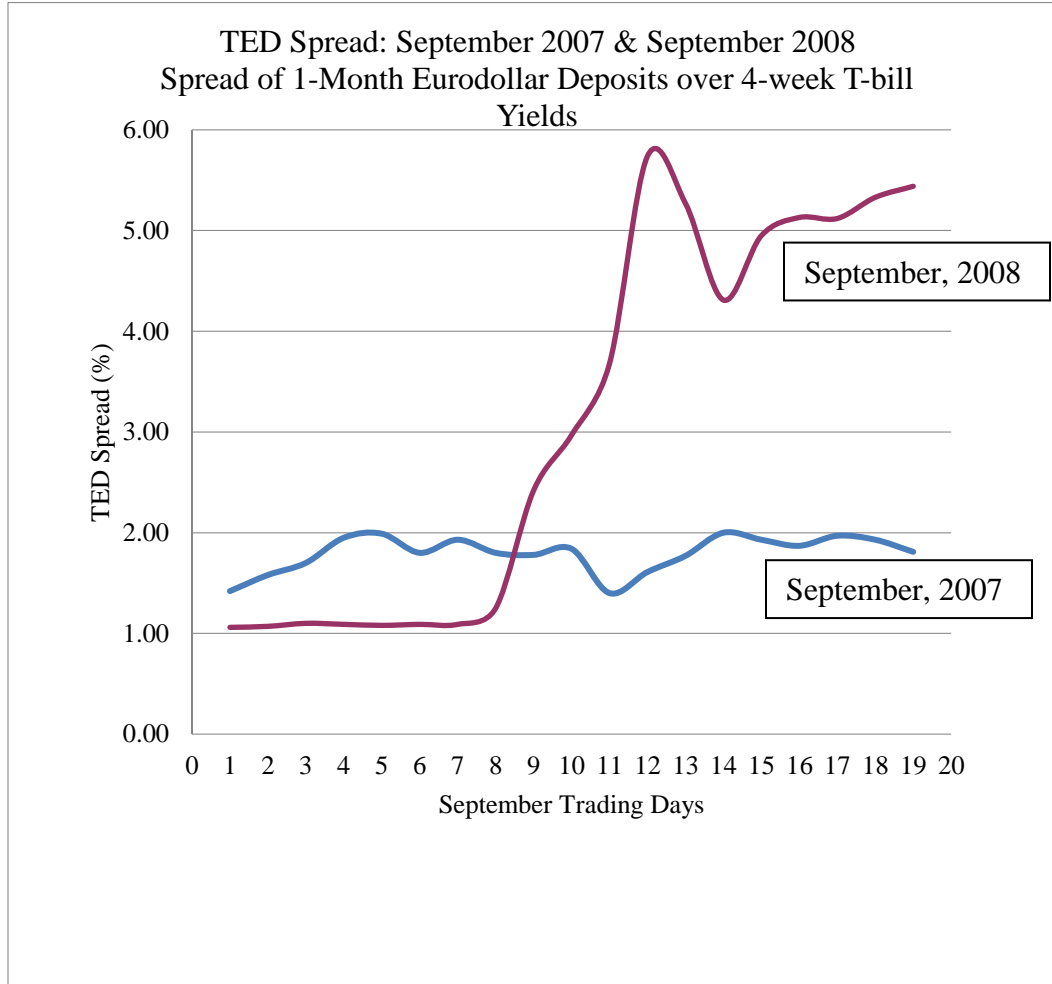
One immediate response to the previous statement could be that money market investors should put their funds in insured bank deposits. However, there are two problems with this argument; [1] the FDIC insurance limit was \$100,000 while a round lot for T-bills in institutional trading is \$5,000,000, hence deposit insurance does not cover the typical transaction size¹⁰ and, [2] even when a deposit is insured, there can be delays when a bank becomes insolvent, which would prevent access to the funds when

needed. Since money market investments are designed to fit specific cash obligations, any delay is unacceptable. One way to view the low September 2008 yields is that investors are buying a form of deposit insurance from the US government. That is, money market investors are lending their money to the US government at such low rates to ensure that their funds are returned to them in full at the contracted time.

However, the low yields in September 2008 also reflect actions by the Federal Reserve to increase liquidity in the market. As such, these yields cannot be viewed in isolation and it is important to examine the risk in the economic context. In this market, this is usually done through an examination of the TED spread, the difference between an unsecured one-month Eurodollar deposit and the four-week Treasury bill. We present these data in Figure 2.

As shown, in September 2007, with the first few rumblings of the crisis becoming known, the TED spread was generally less than 200 basis points, which is generally indicative of minimal concerns about the price of risk. In early September 2008, after several Federal Reserve actions to inject liquidity, concerns had calmed to the point where the spread hovered around 100 basis points. With the Lehman Brothers bankruptcy however, confidence in the market in general and in financial institutions in particular fell to the point where the TED spread peaked at 574 basis points, considerably higher than in September 2007.

Figure 2



B. Commercial Paper

Commercial paper (CP), like T-bills, is a discount instrument but was traditionally the unsecured short-term debt of private corporations with maturities of between one and 270 days. Throughout the 2000s, there were between 1,000 and 2,000 issuers with a total volume of outstandings well in excess of \$1 trillion. Importantly, CP issuers who are generally large and have very high credit quality, are not homogeneous. One distinction is between non-financial CP and financial CP (issued by financial institutions, primarily bank-holding companies and finance companies). A second distinction is based on

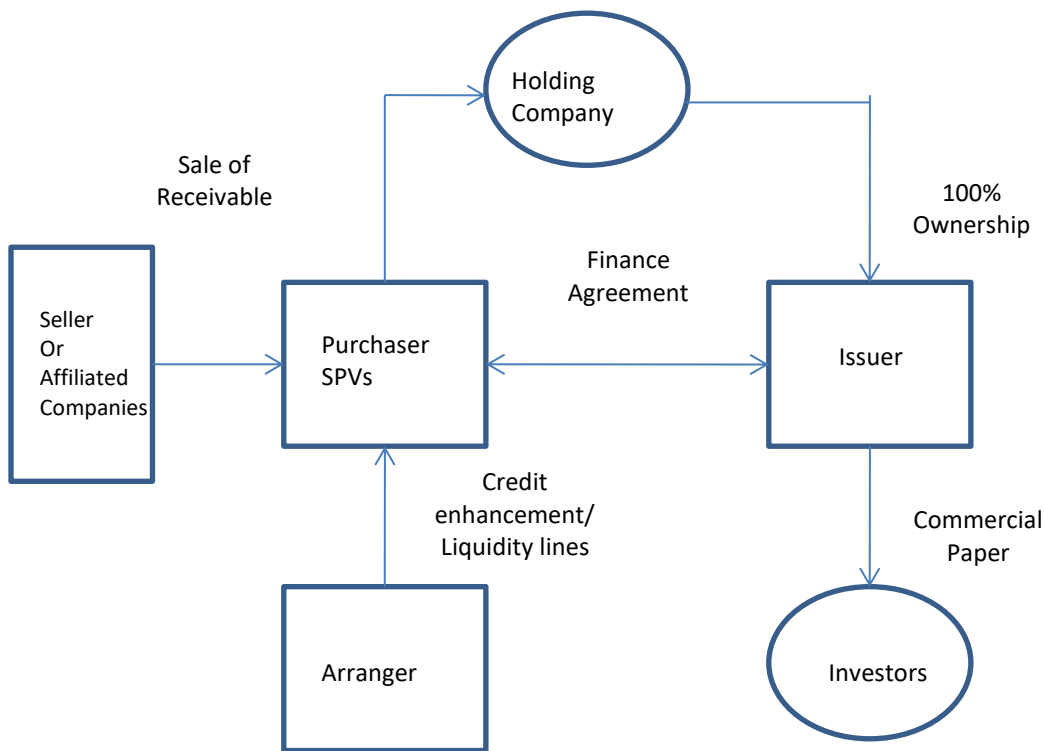
credit risk and is identified through a credit rating system. More than 95% of all issuers are in the top two CP rating categories, A1/P1 and A2/P2.

Because the intermediary is bypassed, commercial paper is a cheaper source of short-term funding for corporations than bank loans. Non-financial CP issues (less than 15% of the market) are usually backed by bank lines of credit, which covers rollover risk but not default risk. That is, issuers frequently roll over CP instead of retiring it by having the new CP repay the maturing CP and thus, on occasion, creating a timing problem. The back-up lines of credit exist to eliminate this rollover risk by providing immediate access to liquidity when such timing problems occur. However, a bank can refuse to extend a loan in the case of a *material adverse change* in the borrower's financial condition which can be invoked in instances where the issuer's credit rating may have or is changing. Note that when a bank honors the back-up line of credit, it will directly affect its balance sheet.

Historically, most commercial paper has been unsecured, backed only by a firm's ability to generate cash flows. With the advent of securitization and asset-backed securities, asset-backed CP (ABCP) has become a significant part of the CP market and an important funding source for the shadow banking sector. An institution issuing ABCP sells its assets to a bankruptcy-remote SPV or SIV. The financial assets serving as collateral may be accounts receivable or a mix of many different assets (including or limited to subprime mortgages), which are jointly judged to have a low risk of payment default by a ratings agency. See Figure 3 for the mechanics of ABCP. In 2007-2008, many of these assets performed more poorly than expected, making investors much less willing to purchase ABCP.¹¹ As markets became unwilling to purchase ABCP because of

valuation issues, cash flow issues arose for institution relying on rolling over their ABCP to finance longer-term investments.

Figure 3
Mechanics of Issuing Asset Backed Commercial Paper



Recall that ABCP conduits such as SIVs and SPVs are operating entities that purchase long-term asset-backed securities and finance them with short-term debt, principally commercial paper. Carey et al. (2009) report that prior to the crisis, ABCP conduits held approximately \$1.4 trillion in total assets most of which were sponsored by banks. Covitz et al. (2009, p.7) report that “*more than half of ABCP daily issuance has maturities of 1 to 4 days [referred to as overnight], and the average maturity of outstanding paper is about 30 days.*” SIVs set up by some commercial banks had been

very profitable when ABCP was considered safe (so that ABCP investors accepted a low interest rate), but forced SIVs to quickly liquidate their longer-term investments, sometimes at substantial losses, when they were no longer able to sell ABCP.¹²

An often repeated comment in the media was that the CP market ‘froze’ at the beginning of the financial crisis with no borrower able to access the CP market.¹³ Figure 4 provides outstanding CP amounts in all maturities of total, non-financial, financial, and asset-backed CP, and provides a number of important insights:¹⁴

[1] non-financial CP, the traditional category of unsecured corporate debt, is relatively stable across the financial crisis, although there is a small downturn following the Lehman bankruptcy. The relatively stable amount outstanding in non-financial CP indicates that contrary to popular belief, this segment of the market continued to function.

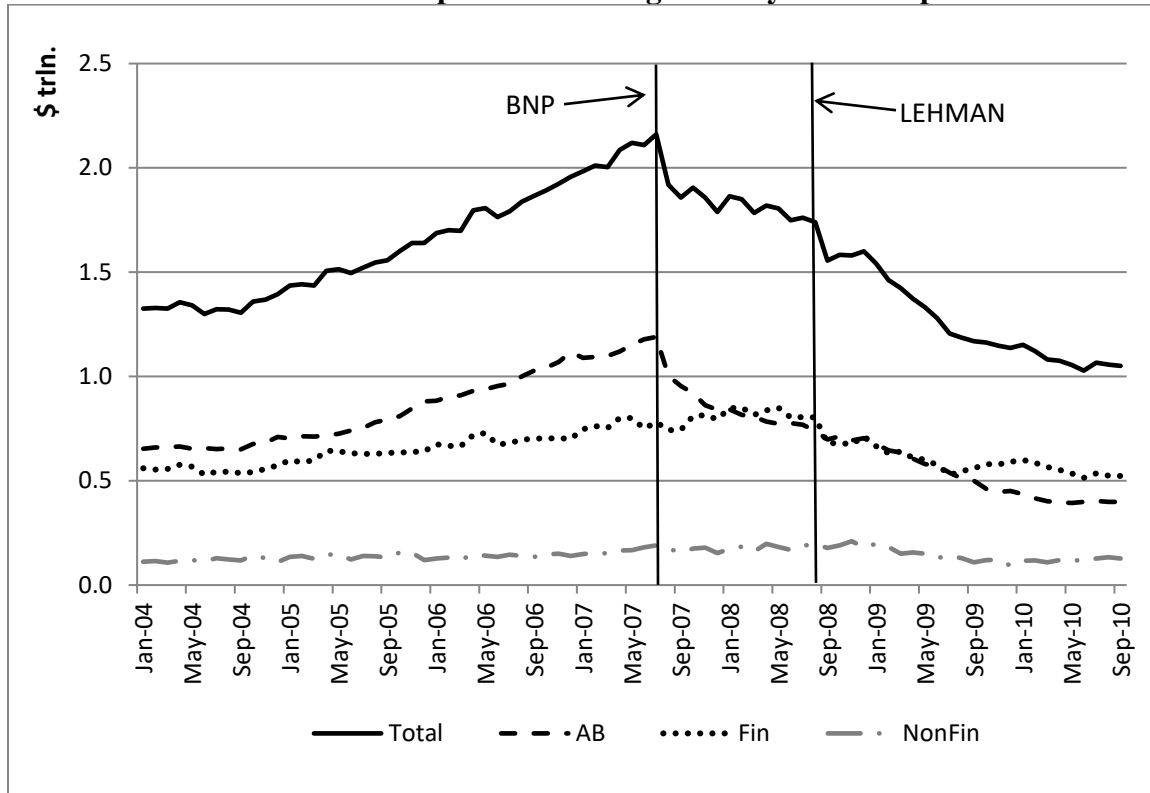
[2] The CP market peaked at about \$2.2 trillion outstanding just prior to the BNP announcement and declined steadily to a little over \$1 trillion. The CP market contracted, basically returning to the pre-housing bubble levels of about \$1.3 trillion in January of 2004.

[3] The vast majority of the contraction in the CP market occurred in ABCP which peaked at \$1.2 trillion in June of 2007 just prior to the BNP announcement and declined to about \$400 billion.

[4] Financial CP peaked at about \$800 billion before the Lehman bankruptcy only to decline to about \$500 billion as lenders became concerned about the stability of the entire financial system, again returning this segment to pre-housing bubble amounts outstanding.

The point of Figure 4 is that all of the CP market did not freeze. Instead, specific segments with specific risks declined.¹⁵

Figure 4
Amounts of Commercial Paper Outstanding January 2004 – September 2010



After the Lehman Brothers bankruptcy on September 15, 2008, a large institutional MMF, Reserve Primary, “broke the buck.” That is, it had a negative return on investment, due to its holdings of \$785 million of the Lehman-issued commercial paper. This was only the second occurrence of breaking the buck in the 35-year history of the money market fund industry.¹⁶ The event caused something of a panic among institutional money fund investors who started making large withdrawals, causing money funds to liquidate some assets quickly.

Historically, the development of money market funds and the commercial paper market have gone hand in hand: MMFs bought CP in search of superior returns on

relatively safe assets, and firms were encouraged to issue CP because MMFs were willing to buy it. Brennan et al. (2009) report that money market mutual funds managed 24 percent of US business short-term assets in 2006. While all money market securities are fairly liquid, CP is one of the least liquid classes of securities held by MMFs, and the one considered riskiest by investors after the Lehman fall. Consequently, MMFs started avoiding CP, especially the asset-backed, financial, and lower-rated non-financial segments, and switched instead to safe heavens such as U.S. T-bills, driving the demand for commercial paper down and yields up.¹⁷ Brennan et al. (2009) report that MMFs faced with the potential of breaking the buck on investments created a ‘run’ on conduits and SIVs forcing the latter to sell assets at ‘fire-sale’ prices. This flight to quality involved investors who moved assets out of MMFs that invested mainly in private sector debt into those that invested primarily in US Treasury debt. From September through December 2008, Brennan et al. report the private sector debt MMFs suffered a net cash outflow of \$234 billion and the US Treasury MMFs received a net inflow of \$489 billion.

The Federal Reserve started operating the Asset Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) on September 22, 2008, which financed purchases of CP by banks and other institutions from MMFs. The Department of the Treasury, in turn, announced it would insure MMFs from breaking the buck. This measure stopped the wave of withdrawals from MMFs. The Federal Reserve created the Commercial Paper Funding Facility (CPFF) that became operational on October 27, 2008 and purchased A1/P1 rated CP from issuers at the overnight index swap (OIS) rate plus 200 bps.¹⁸ Asset-backed CP was purchased at the OIS plus 300 bps.

Financial CP rates increased following the Lehman failure and remained high until the implementation of the CPFF. At this point, AA-rated financial CP rates dropped below the rate charged by CPFF. The CPFF program held approximately 15% and 25% of the CP outstanding in November and December of 2008 (see Figure 5 in Kaperczky and Schnabl (2010)), and those paying the CPFF rate would be the higher-risk borrowers within each class. A2/P2 rated CP was not eligible for CPFF purchases and, as a result, the yields of A2/P2 CP remained very high through the end of year 2008.

There are a couple of important points to reiterate here. First, the CP market is not homogeneous. Second, the CP market did not stop functioning. It continued to function properly, but saw dramatic declines in specific segments because of specific risks. Finally, the CP market responded to the financial crisis in a manner consistent with its economic role. That is, money market investors declined to lend when they were concerned about getting their funds back on time and in full.

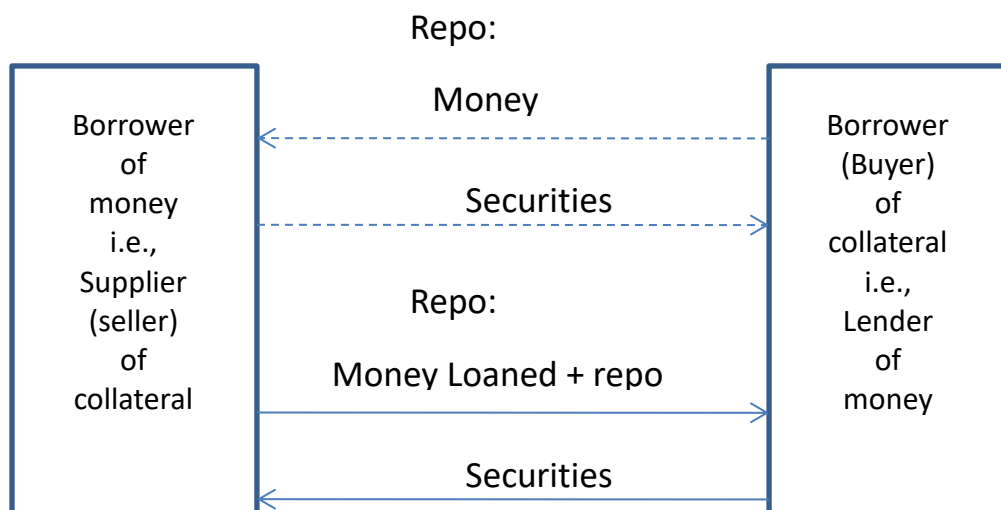
C. Repurchase agreements and their role in the total banking sector

A repurchase agreement (also known as a repo or sale and repurchase agreement) allows a borrower to use a financial security as collateral for a cash loan at a fixed rate of interest. The borrower agrees to sell a security to a lender and also agrees to buy the same security back from the lender at a specified price at a later date. Thus, a repo is equivalent to a cash transaction combined with a forward contract (see Figure 5). The cash transaction results in funds transferred to the borrower in exchange for the legal transfer of the security to the lender (which is generally held by a trustee), while the forward contract ensures repayment of the loan to the lender and the return of the

collateral. The difference between the forward price and the spot price is the interest on the loan and the settlement date of the forward contract is the maturity date of the loan.

Economically, a repo is a secured loan, with the buyer (the lender) receiving securities as collateral to protect against default of the seller (the borrower). Almost any security may be employed in a repo, although highly liquid securities (especially T-bills and GSE debt) are preferred as they can easily be liquidated in the case of default. Unlike in a secured loan, legal title to the securities clearly passes from the seller to the buyer.

Figure 5: Repurchase Mechanics
Stage 1 can be viewed as the collateralized borrowing or ‘sale’;
Stage 2 reverses the transaction and delivers repo interest



Adapted from Stigum & Crescenzi (2007)

There are three types of repo maturities: overnight, term, and open. Overnight refers to a one-day maturity transaction. A term repo has a specified end date (longer than one day). Open repos simply have no end date – they are made on a rolling day-to-day

basis with no final maturity; both the lender and the borrower have the right to immediate termination. While repos are typically short-term, pre-crisis it was not unusual to see repos with a maturity as long as two years.

Repos occur in three forms: *specified delivery*, *tri-party*, and *held in custody*. The first form, specified delivery, requires the delivery of a pre-specified bond at the onset and at maturity. Tri-party is a basket form of transaction which allows for a wider range of instruments in the basket or pool and utilizes a clearing agent or bank making them a more efficient form of repo transaction. The third form is rare in developing markets primarily due to risk of having the lender of the funds declare insolvency while holding the borrower's securities. Regaining the securities in such cases can be a long and difficult legal process.

Because the value of the collateral may fall, repos are over-collateralized through a mechanism known as a haircut. For example, a 2% haircut results in the seller (borrower) receiving 98% of the market value of the securities from the buyer and the interest is calculated on this latter amount. Below we reproduce Table 4 from Krishnamurthy (2010) in which he reports changes in repo haircuts from the Spring of 2007 through the Spring of 2009.

Table 2

	Repo haircuts (%)			
	Spring 2007	Spring 2008	Fall 2008	Spring 2009
US Treasuries (short-term)	2	2	2	2
US Treasuries (long-term)	5	5	6	6
Agency mortgage backed securities	2.5	6	8.5	6.5
Corporate bonds, A-/A3 or above	5	10	20	20
Collateralized mortgage obligations, AAA	10	30	40	40
Asset-backed securities, AA/Aa2 and above	10	25	30	35

The Federal Reserve engages in repos by buying Treasury, agency, or mortgage-backed securities from primary dealers who agree to buy them back, typically within one to seven days; in a reverse repo, the Fed sells securities and repurchases them later.¹⁹ Both repos and reverses are considered open market operations (OMO) with interest rates determined via auction. In a repo, primary dealers bid on borrowing money based on various types of general collateral. In a reverse repo, dealers offer interest rates at which they would lend money to the Fed.²⁰ During the crisis, the Fed expanded the nature of the collateral acceptable for open market operations, effectively changing the market's standards.

Repos in which the lender agrees to accept any security of a given class (e.g., U.S. Treasury or GSE debt) as collateral are *general* repos. In a *special* repo, the lender requires a specific security as collateral. Thus, special repos are basically a mechanism for borrowing specific securities. A particular Treasury issue may “go on special” when there are large short positions which may result from underwriters who want to hedge their inventory of corporate debt securities. It is not uncommon to observe special repo rates significantly below general collateral rates.²¹

The repo market had two principal roles in the financial crisis: (1) funding of traditional bank assets and investment bank inventory and (2) Federal Reserve temporary open market operations. The latter are discussed elsewhere in this paper, so we focus here on the investment banks' use of repos.

Blackwell, Griffiths and Winters (2007, chapter 2) provide the following aggregate balance sheet (Figure 6) for securities firms.

Figure 6

Securities Companies Assets and Liabilities
(as a percentage of total assets)

Assets	%
Cash	1.04
Receivables—dealers, brokers, etc.	38.59
Receivables—customers	4.88
Receivables—noncustomers	0.47
Reverse repurchase agreements	24.73
Securities owned	26.20
Other	4.09
Liabilities	
Bank loans	1.61
Repurchase agreements	41.29
Payables—dealers, brokers, etc.	19.38
Payables—customers	11.87
Payables—noncustomers	1.94
Securities sold short	11.21
Accounts payable and accruals	6.29
Notes and mortgage	1.48
Other	2.10
Equity	2.83

It is clear that repos are the largest source of funds for securities firms and are a major asset class as reverses, used to acquire securities for sale. The repo market is also one of the largest segments of the money markets, with \$3.3 trillion outstanding at the end of April 2006 (Stigum and Crescenzi, 2007). Tri-party repos, the most common form used by securities firms, peaked at \$2.8 trillion in early 2008, but declined to \$1.7 trillion by the first quarter of 2010. At the peak of the market, the largest dealer positions exceeded \$400 billion.²² According to the Report of the Money Market Working Group (2009) in December 2008, MMFs alone held \$552 billion in (reverse) repurchase agreements.

As the financial crisis unfolded, concerns about all securities firms' financial conditions mounted to the point where Bears Stern became illiquid. At this point, lenders

were concerned about the ability to be repaid and, in the case of default, the ability to liquidate collateral (especially risky collateral) in a timely and orderly manner.²³ With these heightened concerns over risky collateral, the repo market saw a form of flight to quality as it moved increasingly toward demanding T-bills as collateral. This made T-bills scarce and lead to a significant increase in the number of Treasury settlement fails.²⁴ As a result, it became increasingly difficult for securities firms to continue to operate in their usual manner. Hordahl and King (2008) note that as the crisis progressed, the rate on US government-backed repos declined relative to the OIS rate for a comparable maturity, while the rate on riskier collateral rose relative to the appropriate OIS rate benchmark.

Returning to Table 2, we see that as the crisis unfolded, the size of the haircuts grew. Thus, the value of the risky assets on banks' balance sheets became increasingly questionable and unavailable for use in the raising of funds. In the Spring of 2007, collateralized mortgage obligations worth \$100 million dollars could be used to raise \$90 million in cash. By Spring 2009, this same amount of collateralized mortgage obligations would raise only \$60 million. This is equivalent to bank creditors withdrawing \$30 million in deposits. Hence, banks would have to sell additional securities to raise funds, which drive the asset values lower, thereby reinforcing the cycle: lower prices, less collateral, more concerns about solvency and increasing haircuts. Gorton and Metrick (2011) report that several classes of assets stopped entirely from being used as collateral. This was an unprecedented event that is equivalent to a haircut of 100%. With haircuts increasing, the financial system either had to shrink or banks had to find additional capital in the form of external equity injections (which several firms, including Citigroup,

Merrill Lynch and Morgan Stanley did, during the fall of 2007).²⁵ Unfortunately, these sources dried up quickly as the financial crisis progressed.

Uncertain about the solvency of counterparties, repo depositors became concerned that the collateral might not be liquid; if all firms wanted to hold cash – a flight to quality – then collateral would have to decline in price to find buyers. This in turn gave rise to a serious liquidity concern in that institutions began to believe that there was no private agent or entity large enough to buy sufficient assets to solve the problem. Left with the only alternative of selling assets, the outcome was that prices had to fall and losses had to be realized.

To demonstrate the full impact of this issue, we now provide an example of leveraging and de-levering of a bank's balance sheet under mark-to-market accounting as asset prices change and include in this example the role of the repo market.

When balance sheets are marked-to-market, changes in asset prices show up immediately on balance sheets and have an immediate effect on the net worth of all members of the financial system. The net worth of traditional banks and investment banks is particularly sensitive to fluctuations in asset prices given the highly leveraged nature of (virtually all) banks' balance sheets.

Consider some basic arithmetic related to the balance sheet of investment banks. Suppose a bank with 10% equity holds \$50 million in Treasuries and cash and \$50 million in risky mortgage securities. The initial balance sheet would look like:

Assets	Liabilities
Treasuries & cash =50	Debt = 90
Risky securities =50	Equity =10

Assume that the assets are marked to market and that the value of debt stays roughly constant at 90 for small shifts in the value of total assets. Hence, total leverage is: $\text{Leverage} = \text{Assets}/(\text{Assets}-\text{Debt}) = 100/(100-90)=10$. Suppose now that the value of the risky securities increases to \$51 million.

Assets	Liabilities
Treasuries & cash =50	Debt =90
Risky securities =51	Equity =11

As a consequence, leverage will fall to $101/11=9.18$. If the investment bank continues to target a leverage ratio of 10, then it must take on additional debt (D) to purchase D dollars worth of securities. That is, $\text{assets}/\text{equity} = (101+D)/11=10$ meaning $D=9$. How does the bank do this? Primarily, through the acquisition of short term debt, most notably repurchase (repo) agreements. Thus:

Assets	Liabilities
Treasuries & cash =50	Debt =90
Risky securities =60	ST Repo = 9
	Equity =11

Although the bank could purchase additional Treasuries, a profit maximizing bank would benefit more by purchasing assets with higher yields. This mechanism works in reverse also. Suppose that there is a shock to securities' prices such that the value of the holdings falls to \$109 million. On the liability side, the equity falls by \$1 million since the value of the debt remains approximately constant.

Assets	Liabilities
Treasuries & cash =50	Debt =90
Risky securities =59	ST Repo = 9
	Equity =10

However, the leverage is now too high and, in order to maintain the leverage ratio of 10 times, the bank can adjust its leverage by selling securities originally worth 10 and paying down the short term repo of \$9 million, returning the balance sheet to its initial position. As Adrian and Shin (2008) point out, the significance is that bank leverage is pro-cyclical and, in particular, they report that repo growth explains 43% of the variation in leverage growth. This means that increases in securities' prices lead to purchases of additional (often risky) securities and increases in leverage while decreases in securities' prices lead to sales of securities and decreases in leverage. When securities prices go up, the upward adjustment of leverage entails purchases of securities that are even larger than that for the case of constant leverage. If there is the possibility for positive feedback, then the adjustment of leverage and price changes reinforces each other in an amplification of the financial cycle.

Finally, to conclude our discussion on repos, we must mention the misuse of repos by Lehman Brothers. In a series of seemingly innocuous transactions, repos were used by Lehman Brothers to mislead investors in several quarters prior to its bankruptcy filing.²⁶ Lehman employed so-called (within Lehman) "Repo 105" and "Repo 108" transactions to temporarily remove securities inventory from the balance sheet in late 2007 and 2008.²⁷ Repo 105s were similar to standard repos with the critical difference

that Lehman accounted for Repo 105 transactions as “sales” rather than as financing transactions based upon the overcollateralization or higher than normal haircut in such transactions.

Lehman then used 105 and 108 repos to report lower balance sheet leverage. By classifying these transactions as sales, Lehman removed the inventory from its balance sheet in the days just prior to reporting dates. The cash was then used to pay down other liabilities, thereby reducing both the total liabilities and the total assets reported on its balance sheet and lowering its leverage ratios. A few days after the reporting date, Lehman would borrow the necessary funds to repay the cash borrowing plus interest due, repurchase the securities, and restore the assets to its balance sheet. Lehman did not publicly disclose its use of Repo 105s, its accounting treatment for these transactions, the increase in Repo 105 usage in late 2007 and 2008, or the impact on the publicly reported net leverage ratio.²⁸

D. Federal (Fed) funds

The Monetary Control Act of 1980 requires that depository institutions in the US keep a percentage of their deposits on reserve at the Federal Reserve. The percentage of deposits held in reserve and how these reserves are reviewed for compliance purposes are defined in Regulation D (Reg D) of the Code of Federal Regulations. Depository institutions subject to Reg D trade reserve deposits in the federal (fed) funds market to manage their reserve positions for compliance purposes. Because fed funds trading involves reserve deposits used for compliance with Reg D, depository institutions are very default-risk averse in this market.²⁹

There are many Reg D details that are important to depository institutions and to understanding the operations of this market however, access to the fed funds market is limited to traders with reserve deposits, which keeps many money market traders from participating in this market. The result is that understanding fed funds trading is not central to understanding the role of this money market in the financial crisis. Accordingly, we will not detail the operations of the fed funds market here and instead refer the readers to Spindt and Hoffmeister (1988), Griffiths and Winters (1995), Cyree, Griffiths and Winters (2003) and Clouse and Dow (2002) for the details. This section continues with the actions of banks and Federal Reserve during the financial crisis that relate to the fed funds market.

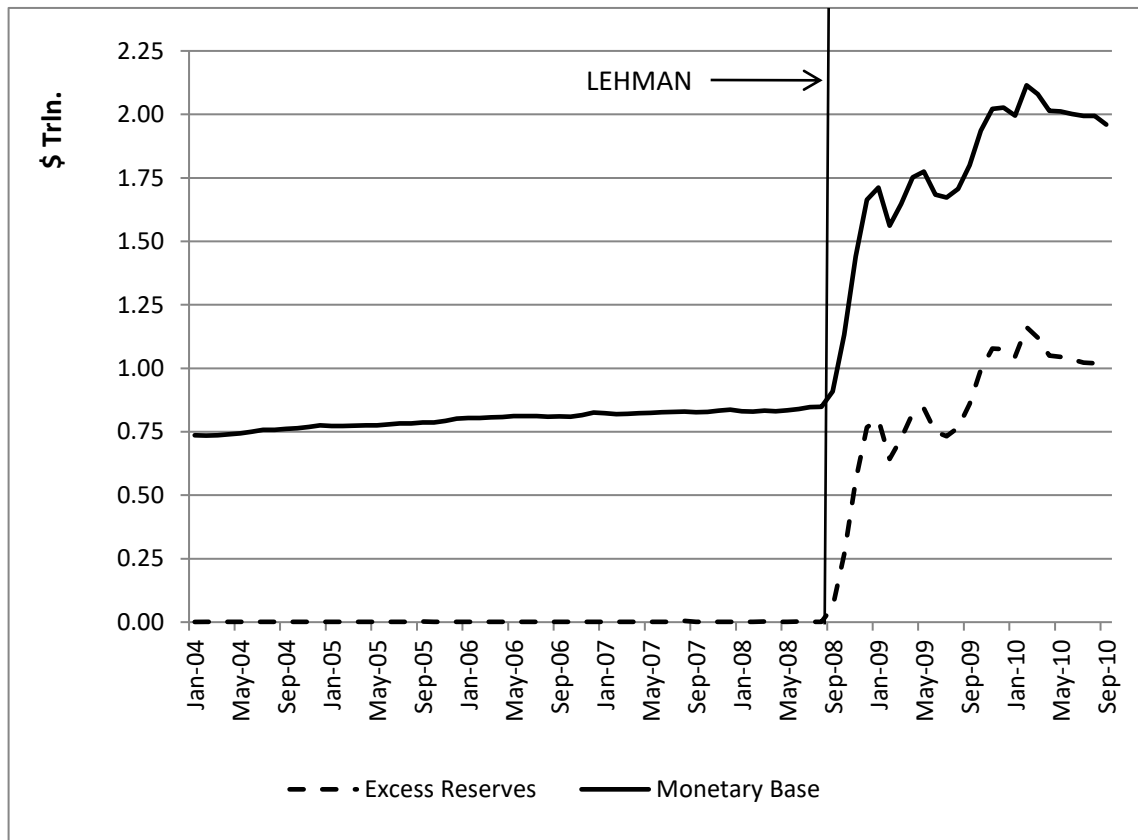
Because fed funds are the most liquid assets in the financial system, the fed funds rate is sensitive to changes in the money supply. Since 1982, the Fed has conducted monetary policy by setting a target fed funds rate (TFFR) at a particular level and then ensuring that the actual (market-determined) fed funds rates are close to the target. The approximation of the actual fed funds rates is the effective federal funds rate series (EFFR); it is a weighted average of the rates on brokered trades reported to the Federal Reserve by the federal funds brokers. While small and/or temporary deviations of the effective rate from the target rate are of little concern for the Fed, if the EFFR is significantly higher (lower) than the TFFR, the Fed would act by increasing (decreasing) money supply, usually through the use of purchases (sales) of government or agency securities from primary dealers (open market operations).³⁰

Reserves above the Reg D requirement are known as excess reserves. During the first six months of 2008, total depository institutions' reserves ran at about \$43 billion

with excess reserves at around \$2 billion (see Figure 7). For the two-week period ending October 8, 2008 estimated total reserves were \$179 billion with excess reserves of \$136 billion.

Why would depository institutions hold such high levels of excess reserves? One answer is that when the money markets are not functioning properly, the only way for banks to ensure that they have enough cash to cover customer withdrawal demands (liquidity risk) is to hold more cash, and it is much less costly to hold substantial excess reserves than to risk not being able to meet withdrawal demands.

Figure 7
Excess Reserves of Depository Institutions
(Federal Reserve Statistical Release H 3)



Afonso et al. (2009) in a study of the federal funds market around the Lehman bankruptcy determine that banks became more restrictive in terms of which counterparties they loaned to in this market. They found that while the market did not contract dramatically, lending rates did increase. After the Lehman collapse, the fed funds market became sensitive to bank specific characteristics, not only in the amounts loaned to borrowers but even in the cost of capital. Large banks showed reduced amounts of daily borrowing and borrowed from fewer counterparties. Smaller banks increased the amount borrowed and added lending counterparties during the crisis.

On October 6, 2008, the Fed announced that it would start paying interest on required and excess reserve balances.³¹ The rate on required balances was set equal to the target fed funds rate set by the Fed minus 10 basis points (0.1%), and the rate on excess reserves was set at 75 basis points below the TFFR. Thus, holding excess reserves would still involve an opportunity cost (assuming that the actual Fed funds rate is close to the TFFR). However, in mid-December 2008, the Fed reduced the TFFR to between 0 and 0.25% and set the interest rate on both required and excess balances at 0.25%. At the time of this writing (July 2011), this is still the case. Because banks earn as much, if not more, by holding excess reserves than they would by lending to other banks in the fed funds market, they are effectively discouraged from lending and encouraged to hold excess reserves. For the week ended October 27, 2010, the total depository institutions reserves stood at just over \$1trillion. The overwhelming majority of this amount (at least 90%) is excess reserves. This is representative of most of 2009 and 2010. While it is not clear whether depositories would be holding as much in excess reserves if they did not earn

interest on these balances, the financial crisis made many institutions much more cautious and conservative in their lending decisions.³²

As banks became more conservative during the crisis, they held increasing amounts of excess reserves because they had funded illiquid loans with highly liquid deposits. Typically, banks manage liquidity (1) by holding enough cash for a few days of normal withdrawals, (2) by storing cash in liquid money market securities, and (3) by having access to borrowed liquidity in the money markets (such as the fed funds market). In the current crisis, borrowing funds in the money markets became more difficult. In addition, with money market trading slowing down, banks could not rely on retrieving the liquidity stored in money market securities on short notice. Thus holding cash became, by far, the most reliable source of liquidity which they funded with excess reserves.

Banks typically use deposited cash to make loans that generate profits. While profits are a long-term goal of all businesses, in the case of banks, the short-term goal of meeting withdrawal demands dominates. Without properly functioning money markets, banks will increase their cash holdings to ensure survival, making it more difficult for individuals and businesses to get the loans they need.

Figures 8 and 9 provide data on the bank balance sheets, and we divide the discussion into before and after the Lehman bankruptcy.

The period before the Lehman bankruptcy includes the beginning of the crisis where banks operated as usual. The total assets of domestically chartered US banks increased steadily until the Lehman bankruptcy with the asset growth prior to the financial crisis being driven by the (housing) loan growth. Through the first three

quarters of 2006 deposit growth was able to fund this growth, but from that point through the Lehman bankruptcy deposit growth lagged. Banks covered the difference through short-term (i.e., money market) borrowings.

After the Lehman bankruptcy there is a very different view of the banks' balance sheet. First, total assets spike and then decline somewhat. The decline in total assets is mirrored by declines in loans and borrowings. Thus, as loans decline banks can repay the borrowings that funded the pre-Lehman loan growth. We note that it has been popular in the press to say that banks are "not lending" post-Lehman. Bank loan portfolios include short-term loans and loans with regular repayment schedules, so that without new loans the amount of loans would decline rapidly. The loan plot in Figure 8 suggests a decline post Lehman consistent with an increase in credit standards, followed by an increase in loans at the beginning of 2010. This suggests that banks continue to make loans, although with perhaps substantially higher credit standards. Finally, Figure 9, which plots three out of the six series from Figure 8, shows a combined increase in cash and securities of about \$1 trillion, as well as a decrease in borrowing of about \$0.5 trillion post-Lehman. Banks typically hold about 5 times as many assets in money market securities as in cash, but the post-Lehman increase leans toward cash. This suggests that banks were concerned, in part, about how well the money markets were functioning. The \$1 trillion increase in cash and money market securities mirrors the \$1 trillion increase in excess reserves seen in Figure 7.

Figure 8
Aggregate Balance Sheet Items
From Domestically Chartered Commercial Banks

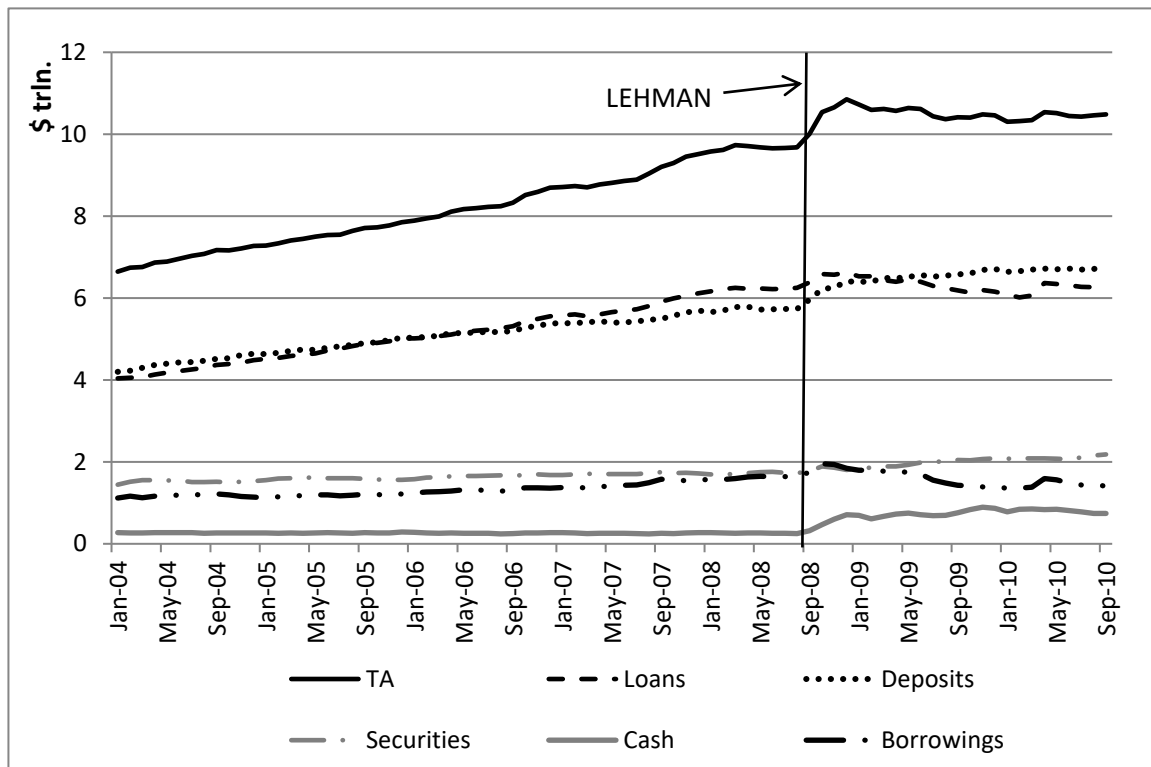
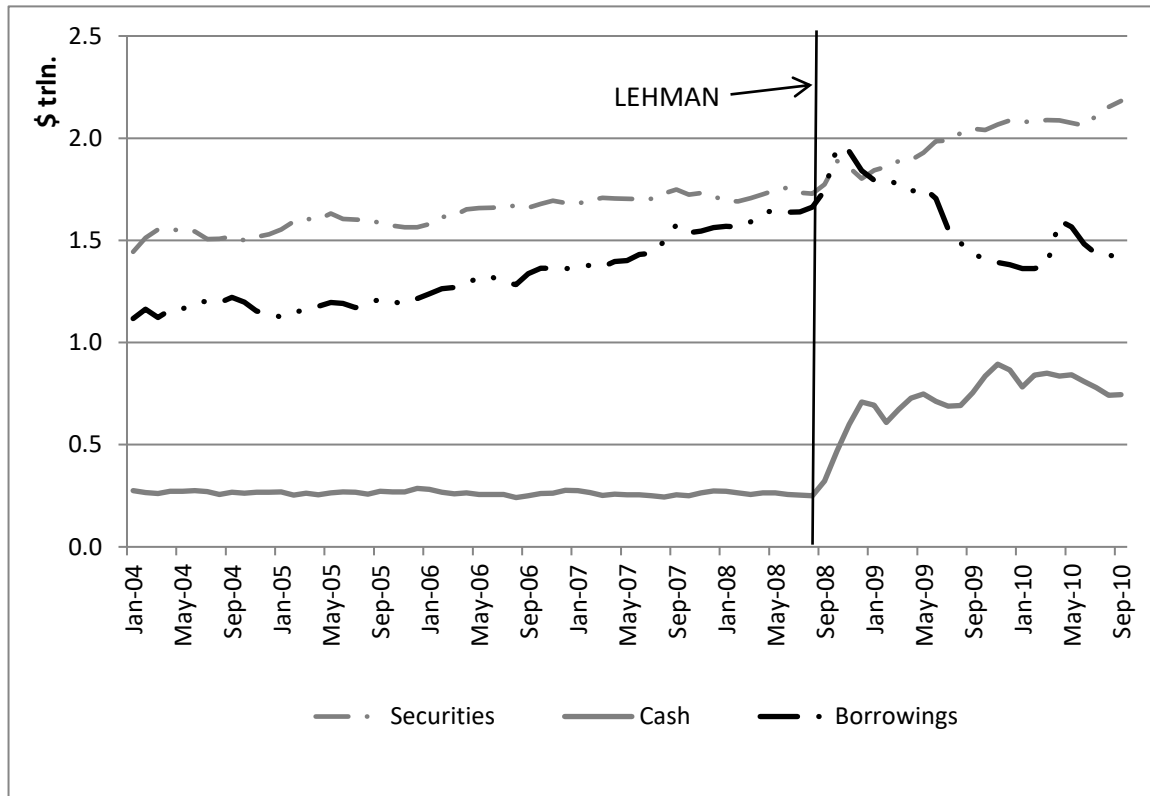


Figure 9
Aggregate Balance Sheet Items
From Domestically Chartered Commercial Banks



To reinforce the points made earlier on the lack of confidence in the lending markets and the potential for higher credit standards, we summarize the findings of Ivashina and Scharfstein (2010) below. Based upon their analysis of data from Reuters' DealScan database of large bank loans, the authors glean the following facts:

- New lending in 2008 was significantly below new lending in 2007 even before Lehman failure.
- The decline in new loans increased during the panic. The dollar volume in 2008:4 was 47% lower than in the previous quarter and the number of issues was 33% lower.
- The dollar volume of restructuring loans in 2008:4 (for M&A and share repurchase purposes) was 84% below its peak and the dollar volume of real investment was 72% below its peak. Respectively, these loans were 60% and 14% less than in the previous quarter.

- In 2008:4, investment grade lending was 77% lower and non-investment grade lending was 91% lower than their peaks during the credit boom. Respectively, they were 22% and 75% lower than in the previous quarter.
- In 2008:4 new issues of credit-line facilities fell by 67% and term loans fell by 27%.

IV. The Fed and other Market Interventions: Pre- and Post-Lehman

The Fed is an active participant in the money markets during normal market conditions and it increased its role during the financial crisis. This section discusses the role the Fed and other government market interventions played in dealing with the financial crisis and is divided into the pre- and post-Lehman periods because the types of interventions changed dramatically following the Lehman bankruptcy.

The Federal Reserve was created by the Federal Reserve Act in 1913 to have four broad powers: (1) to provide an elastic money supply, (2) to be a lender of last resort to depository institutions, (3) to provide for a sound banking system and, (4) to improve the payment system. The first three powers clearly give the Fed a role in managing the current financial crisis with the first two relating directly to the money markets.

The Fed actively manages the money supply through open market operations (OMO), the buying and selling of securities on the open market. Each business day at approximately 9:30AM, the Federal Reserve Bank of New York announces whether it will buy (add money), sell (drain money), or abstain from trading on that day. If the Fed deems that the needed change in the money supply should be temporary in nature, it trades assets via repurchase agreements (repos) and reverses instead of outright sales and purchases of securities. Historically, the Fed traded T-bills in OMO. However, commencing in December 2007, the Fed has also traded agency debt and (most recently)

mortgage-backed securities. Open market operations averaged about \$10 billion per day in 2006 and 2007.

The Fed's lender of last resort power has traditionally operated through the discount window which is designed for depositories to be able to borrow when they need liquidity but cannot obtain it from the market. This has a negative connotation because only 'high-risk' borrowers would not be able to borrow the needed liquidity from the money markets under normal conditions, so banks generally avoid going to the discount window. In addition, discount window borrowing requires the provision of collateral while most money markets do not (the clear exception is the repo market). Concerns that banks did not and would not access the discount window for needed liquidity led the Fed to make some recent changes to its discount window policies.

Historically, access to the discount window was tightly constrained. Specifically, use of the window was limited to depository institutions with very specific types of collateral. To ensure adequate liquidity during the current crisis, the Fed has opened the discount window to other types of financial institutions (e.g., AIG, Goldman Sachs, JP Morgan) and has dramatically broadened the collateral acceptable for discount window loans. The specifics of the changes to the discount window are beyond the scope of this paper.³³

The Fed has worked throughout the crisis to attempt to ensure adequate liquidity in the market. However, the media frequently referred to the crisis as one of liquidity and then complained that the Fed was not getting the markets to flow freely. At this point, it should be clear that the crisis was not solely one of liquidity. It was also a credit crisis and when such problems exist in the money markets, liquidity will stand on the sidelines

until the lenders are confident in the credit quality of the borrowers, the value of the underlying collateral, and/or their own financial condition.

In the late summer and early fall of 2007, the Fed took several significant steps to provide more access to the discount window. The increased access and the acceptance of a wider range of collateral were designed to make the Fed the liquidity provider that got off the sidelines and lent to more firms that had difficulty borrowing in the money markets.³⁴

Between August 9, 2007, the date of the BNP Paribas announcement and the September 15, 2008 Lehman Brothers bankruptcy filing, the Federal Reserve Board reduced the primary credit rate eight times from 6.25 percent to 2.25 percent. Over the same period, the federal funds target rate was lowered from 5.25 percent to 2.0 percent. A sampling of the other major actions follows:

- August 10, 2007. The Fed announces that it “will provide reserves as necessary...to promote trading in the federal funds market at rates close to the target rate of 5.25 percent.
- December 12, 2007. The Fed creates a Term Auction Facility (TAF) which allocated credit to depositories that submitted bids specifying amounts needed and rates that they were willing to pay. Every successful bidder would then pay the same stop-out rate. This setup required depositories to compete with each other for the funds and thus removed the stigma associated with borrowing from the discount window. TAF became a popular source of liquidity, but the ultimate goal was not achieved, as depositories hoarded the borrowed cash for the most part.
- March 11, 2008. The Fed creates the Term Securities Lending Facility (TSLF) which loaned \$200 billion of Treasury securities to institutions in exchange for much less liquid collateral.
- March 16, 2008. The Fed establishes the Primary Dealer Credit Facility (PDCF) to extend overnight credit to primary dealers against a broad range of investment grade securities. The Fed reduces the primary credit rate, lowering the spread between the primary credit rate and FOMC federal funds target rate to 25 basis points and increases the maximum maturity of primary credit loans to 90 days.

- July 13, 2008. The U.S. Treasury Department temporarily increases the credit lines of Fannie Mae and Freddie Mac and temporarily authorizes the Treasury to purchase equity in either GSE if needed.
- September 7, 2008. The Federal Housing Finance Agency (FHFA) places Fannie Mae and Freddie Mac in government conservatorship.³⁵

Commencing with the Lehman Brothers bankruptcy, the Fed moved from a policy of attempting to improve liquidity to become an active investor/lender. The Fed continued to take steps to ensure the availability of liquidity including continued reductions in the target federal funds rate (to between 0 to 0.25 percent) and continuation of actions under previously announced programs to ensure the expansion of credit terms and the nature of acceptable collateral. The Treasury also became an active investor when, on 21 different occasions between October 28, 2008 and March 27, 2009, the US Treasury purchased approximately \$250 billion in preferred stock from US banks in an effort to reduce the leverage and liquidity crisis. A sampling of the major steps where the Fed or the Treasury became investors in this period follows:

- September 15, 2008. Lehman Brothers Holdings Incorporated files for Chapter 11 bankruptcy protection. Bank of America announces the purchase Merrill Lynch & Co. for \$50 billion.
- September 16, 2008. The Fed authorizes the Federal Reserve Bank of New York (FRBNY) to lend up to \$85 billion to the American International Group (AIG).
- September 19, 2008. The Fed creates the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF). The Treasury Department announced that it would insure MMFs from “breaking the buck.”
- October 3, 2008. Congress passes and President Bush signs into law the Emergency Economic Stabilization Act of 2008, which establishes the \$700 billion Troubled Asset Relief Program (TARP).
- October 7, 2008. The Fed creates the Commercial Paper Funding Facility (CPFF) which provided liquidity directly to the issuers of eligible highly-rated unsecured and asset-backed three-month CP. The CPFF bought both ABCP and unsecured

CP totaling \$738.3 billion, and peaked in mid-January 2009 at \$350 billion, or 21.85% of all CP then outstanding.

- October 8, 2008. The Fed authorizes the FRBNY to borrow up to \$37.8 billion in investment-grade, fixed-income securities from AIG in return for cash.
- November 21, 2008. The U.S. Treasury Department announces that it will help liquidate The Reserve Fund's U.S. Government Fund and agrees to serve as a buyer of last resort for the fund's securities to ensure the orderly liquidation of the fund.
- November 23, 2008. Citigroup will issue preferred shares to the Treasury and FDIC in exchange for protection against losses on a \$306 billion pool of commercial and residential securities held by Citigroup. The Treasury will invest an additional \$20 billion in Citigroup from the TARP.
- November 25, 2008. The Fed creates the Term Asset-Backed Securities Lending Facility (TALF) to lend up to \$200 billion to holders of AAA-rated asset-backed securities and recently originated consumer and small business loans.
- December 29, 2008. The U.S. Treasury Department announces that it will purchase \$5 billion in equity from GMAC.
- January 16, 2009. The U.S. Treasury Department announces that it will lend \$1.5 billion to Chrysler Financial to finance the extension of new consumer auto loans.
- February 10, 2009. The Fed announces that is prepared to expand the TALF to as much as \$1 trillion and broaden the eligible collateral to include AAA-rated commercial mortgage-backed securities, private-label residential mortgage-backed securities, and other asset-backed securities.
- March 18, 2009. The FOMC votes to maintain the target range for the effective federal funds at 0 to 0.25 percent and decides to increase the size of the Federal Reserve's balance sheet by purchasing up to \$750 billion of agency mortgage-backed securities, bringing its total purchases of these securities to up to \$1.25 trillion, and to increase its purchases of agency debt by up to \$100 billion to a total of up to \$200 billion.

As of the week ended on October 27, 2010, the Fed held \$1.06 trillion of MBS, \$834 billion of Treasury and \$150 billion of agency securities. The total assets amounted to \$2.3 trillion, almost three times the pre-crisis level. To finance these assets, the Fed

borrowed more than \$1 trillion from depository institutions (in the form of excess reserves) and about \$240 billion from the Treasury Department via special lines of credit. Starting in late November 2008, the Fed focused on stimulating the economy by expanding its balance sheet through acquiring longer-term assets.

The point of this discussion is to show the dramatic change in Fed/government policy during the financial crisis. Prior to the Lehman bankruptcy the Fed provided liquidity to the market. After the Lehman bankruptcy the Fed and the Treasury became active investors to address specific problems. Griffiths, Kotomin and Winters (2011) examine the commercial paper market across the financial crisis and find little evidence that Fed liquidity facilities in the pre-Lehman period reduced the impact of the crisis, but that later when the Fed became a lender in the CP market, the crisis pressures were dramatically reduced.

V. Policy Implications and Conclusion

Our review of the role of the money markets during the recent financial crisis leads to several future policy implications.

- Money market lenders require the preservation of their funds. When they have concerns about their funds they will withdraw to the sidelines and liquidity enhancements will not get them back in the game. Said another way, lenders do not make bad loans but they do make some loans that go bad. Liquidity enhancement will not convince a lender to make a bad loan. Instead, credit enhancement is required to improve the quality of the loan.

- As long as the shadow banking sector funds long-term assets with short-term loans, it will be exposed to liquidity risk, the ability to roll over its loans on a continuing basis. Since this sector borrows in the money markets, its ability to roll over loans is based solely on the lenders' confidence in the ongoing credit quality of borrowers' assets. Policy makers and investors being aware of this risk will make investors more reluctant to take on counterparty credit risk and will provide policy makers a clearer path to a solution.
- Over time the money markets have evolved to include many securities and programs that do not fit the traditional definition of a money market security; money markets are not what they used to be. Investors have to be more diligent to be informed about the borrower and the borrower's assets. Following the financial crisis we see a push in this direction by policy makers. Rule 2a-7 of the Investment Company Act of 1940 (as amended) defines the assets that can be held in a MMF, and following the financial crisis the SEC has modified the rule to move back toward a more traditional definition of money market securities.
- During the crisis, some money market borrowers could not credibly signal repayment. For example, there was much news about toxic assets in mortgage-backed securities, but no one could determine which mortgage-backed facilities held the toxic assets. One result was the asset-backed CP market as a whole declined dramatically as the lenders stood on the sidelines. Making funds available to lenders (providing liquidity) did not matter without a credible signal of repayment. Policy makers need to develop techniques that increase the transparency of portfolio holdings in conduits, SIVs and SPVs.

The point of this paper is that when money markets cease to function normally, the source of the problem can be a lack of liquidity and/or a lack of confidence. During a crisis that includes questions over the correct valuation of assets, any problem in the money markets may well be a lack of confidence which cannot be overcome simply by providing more liquidity. There is clear evidence that the current crisis was one of confidence given the flight to quality in T-bills, the decline in amounts outstanding of higher risk CP, securities firms having difficulties funding their operations through repos, and banks holding over \$1 trillion in excess reserves.

Footnotes

1. Taylor and Williams (2009) suggest that the current financial crisis commenced in earnest with BNP. A timeline of the financial crisis developed by the Federal Reserve Bank of St. Louis lists 10 items before the BNP announcement, but none would be considered a major trigger of the financial crisis. The timeline is available at <http://timeline.stlouisfed.org/index.cfm?p=timeline>. Brunnermeier (2009) also provides an excellent timeline of institutional events commencing with an increase in subprime mortgage defaults in February 2007 and the increase in the cost of insuring baskets of mortgages with credit default swaps as measured by the ABX price index.
2. The \$32.2 billion in mortgages held for sale includes \$22.5 billion in prime mortgages and \$4.9 billion in non-prime mortgages. The Trading Securities Owned are almost entirely mortgage-backed securities.
3. The funding of mortgage operations and mortgage-backed securities with asset-backed commercial paper was common practice prior to the financial crisis. Covitz, Liang, and Suarez (2009) note that about one-third of asset-backed CP programs failed to roll over their issues within a week in the late 2007.
4. The quote is from the executive summary of the Report of Anton R. Valukas, Examiner in the Lehman bankruptcy case, accessed at <http://lehmanreport.jenner.com>.
5. We recognize that most commercial paper is rolled over, but this is consistent with most inventory being replaced.

6. Gorton and Pennacchi (1990, 1993) define bank debt as being “informationally-insensitive” when such bonds are not subject to adverse information because it is not profitable to produce private information to speculate in these bonds.
7. This number significantly underestimates the use of repos as only the trades of those institutions authorized to trade directly with the Federal Reserve are reported but hedge funds, money market mutual funds and other institutions with large portfolios of securities also participate in this market.
8. See Cyree, Lindley and Winters (2007). Stigum and Crescenzi (2007) note that the market peaked at \$80 billion outstanding in 1984 and declined to only \$4 billion in 2006.
9. The Treasury discontinued auctioning 1-year T-bills after the 2/27/01 auction and re-started regular 1-year T-bill auctions with at the 6/3/08 auction.
10. This limit was raised to \$250,000 on October 3, 2008, the increase authorized by the Emergency Economic Stabilization Act of 2008.
11. Consistent with Markowitz Portfolio Theory, the argument is that the risk of a portfolio of risky assets is less than any single risky asset. Hence the risk of, say, a pool of sub-prime mortgages could be split into tranches ranked AAA through BBB and lower. However, when valuations became uncertain, correlations become positive and the benefit of diversification reduces dramatically.
12. Adrian and Shin (2010, p.6) report that, “*(f)or an off-balance sheet vehicle such as a SIV . . . that finances holdings of mortgage assets by issuing commercial paper, a difference of a quarter or half percent in the funding cost may make all the difference between a profitable venture and a loss-making one.*”

13. Quoting from the Interim Assistant Secretary for Financial Stability Neel Kashkari's speech made on January 13, 2009: *"As a result, credit markets froze. The commercial paper market shut down, 3-month Treasuries dipped below zero, and a money market mutual fund "broke the buck" for only the second time in history, precipitating a \$200 billion net outflow of funds from that market. The savings of millions of Americans and the ability of businesses and consumers to access affordable credit were put at serious risk."*
14. The data is available from the Federal Reserve at <http://www.federalreserve.gov/econresdata/releases/statisticsdata.htm>. The Fed does not provide the amount outstanding in different rating classes. The CP data is available in different maturities. Plots of different maturities are similar to the plots in Figure 4.
15. For readers who want a more in-depth discussion of the changes in the CP market we suggest Griffiths, Kotomin and Winters (2011) and a Federal Reserve Board working paper by Cohen-Cole, Monotorial-Garriga, Suarez and Wu (2010) that reaches the same conclusion.
16. The first case of a money market fund breaking the buck occurred in 1994, when Community Bankers U.S. Government Money Market Fund was liquidated at 94 cents because of large losses in derivatives.
17. Highest-rated (AA) non-financial CP issues did not appear to suffer from lower liquidity or higher yields. However, this segment is the smallest in the CP market (between 10% and 15% of outstanding CP).

18. Overnight Indexed Swap (OIS) rate represents the expected interest rate that would accrue from repeatedly rolling over an investment at the overnight rate for three months.
19. The Fed used the term "matched sale" instead of "reverse repo" before 2003.
20. Collateral pledged by dealers towards repos has a haircut applied, while collateral pledged by the Fed in reverse repos does not.
21. See Duffie (1996) for a detailed discussion of special repos.
22. See the white paper prepared by the Federal Reserve Bank of New York titled *Tri-Party Repo Infrastructure Reform*.
23. See Hordahl and King (2008).
24. In a repo fail, the promise to deliver a security on time is not kept, as the bonds cannot be borrowed and then loaned back out.
25. A non-exhaustive listing includes: [1] the Government of Singapore Investment Corp. and Abu Dhabi Investment Authority invested \$14.4 billion in Citigroup, [2] the Kuwait Investment Authority, the Korean Investment Corp. and Singapore's state-run Temasek Holdings invested about \$10 billion in Merrill Lynch, [3] China Investment Corp. invested \$5 billion in Morgan Stanley, [4] China's government-controlled Citic Securities Co. and U.S. investment bank Bear Stearns agreed to invest \$1 billion in each other, [5] Abu Dhabi-based Mubadala Development Co. invested \$1.35 billion in The Carlyle Group, a private equity firm. And [6] China's state investment company invested \$3 billion in The Blackstone Group, a U.S. private equity firm.

26. The discussion that follows is based on Section III.A.4 of the Report of Anton R. Valukas, Examiner in the Lehman's bankruptcy case. Consult the report for details; accessible at <http://lehmanreport.jenner.com>.
27. The "105" and "108" refer to the haircuts of 5% and 8% necessary to account for the transaction as a "sale" under SFAS 140. Lehman utilized Treasury and agency securities in "Repo 105" transactions and equity securities in "Repo 108" transactions.
28. For example, in the first quarter of 2008 (ending February 28), Lehman's reported net leverage ratio (net assets-to-equity) was 15.4. If Repo 105s and 108s were not classified as sales, it would have been 17.3.
29. Lines of credit are used in the fed funds market for two reasons. First, it allows the lending bank to go through a formal credit analysis for all banks wishing to borrow from it. In this process, the lender determines if it is willing to lend to the borrower and, if so, a maximum loan amount for the line of credit. Second, requiring pre-approved lines of credit allows a transaction request to be completed quickly. When a request comes to the lender, a clerk simply checks to see if a line of credit is in place and if the requested loan amount is less than the amount available under the line of credit. If so, the clerk makes the loan; if not, the clerk rejects the loan request.
30. See Feinman (1993) for a discussion of how the Federal Reserve reacts to deviation of market rates from the policy target rate.
31. However, the *American Banker* reported that the move to paying interest is designed to keep the deposits at the Fed so the Fed could make more loans as it increases access to the discount window and as it began to make a market in commercial paper. The

European Central Bank has paid interest on reserves since introduction of the Euro in 1999.

32. See Griffiths, Kotomin and Winters (2011) who report results from the Federal Reserve survey of senior bank loan officers on changes in lending practice in advance of FOMC meetings. They find that credit standards began to tighten just prior to BNP (8/9/07) and that the tightening peaked around Lehman (9/15/08).

33. We recommend the following links for more details:

<http://www.frbdiscountwindow.org/FRcollguidelines.pdf> and

<http://www.frbdiscountwindow.org/discountwindowbook.cfm?hdrID=14&dtIID=43#eligibility>.

34. Most depositories, however, were still reluctant to borrow from the Fed's discount window.

35. Frame (2008) provides an early analysis of the government intervention into Fannie Mae and Freddie Mac.

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